Motorola
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Communications and Electronics Division.

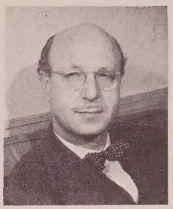
Nov. - Dec. 1955

THE WHITING STORY

In this issue . . . How Motorola 2-Way Radio Stood Up as the Backbone of Successful Disaster Communications

(Cover story on page 4)

What's New In Transistors



D. E. NOBLE

The other day, an engineer who has been exploring circuitry applications with the newest types of transistors, made a statement to me which was terrific in its implications. He said, "The great advantage of the transistor over the vacuum tube is its comparative freedom from frequency limitations." Just think that over for awhile. Up to now, we have been thinking of the transistor primarily as an audio amplifier and we have been hard pressed to develop units which would give good performance at the **I.F.** frequency of 450 Kc. Here we have this radical statement which infers that the transistor is a better high frequency amplifier device than the vacuum tube. This means some kind of new unit. The new transistor is not a surface barrier nor a PNIP type. Obviously something has happened in the transistor art.

We have looked ahead longingly to the surface barrier transistor and to the so-called PNIP transistor for the needed v.h.f. and u.h.f. performance. Unfortunately, the surface barrier has been limited in a practical sense to about 10 Mc. applications, and while the PNIP theoretically could be extended to perhaps a thousand megacycles, no one had discovered a practical way to make the device. The answer to the "new look" in transistors is a change in technique which has been developed by Dr. William Shockley and his group of Bell Lab transistor scientists. The new technique is the use of diffusion, instead of fusion, to form the junction barrier. The fusion process melts indium into a slab of single-crystal germanium. The diffusion process diffuses or evaporates the molecules of the doping material into the germanium. By this diffusion process, it has been possible to construct transistors with cut-offs of 600 Mc. It appears, also, that the diffusion process is a practical process which will yield transistors at low cost. While the amount of information is limited, it appears that devices have been built using the new transistor, with performance characteristics which exceed the high frequency performance of equivalent circuitry with tubes.

You all know that as soon as you reach frequencies above one or two hundred megacycles, the vacuum tube develops troubles. There are many reasons for this difficulty, but one obvious reason is that each connection to the vacuum tube element takes on the characteristics of lumped inductance and capacitance. We attempt to hook our high frequency circuitry onto a vacuum tube with our circuitry isolated from the tube elements by unwanted inductances and capacitances. The higher in frequency we operate, the more difficult it becomes to compensate for the unwanted high frequency parameters of the tube leads. With the transistor, the device itself is tiny in dimension and the leads are correspondingly small. We could build the whole high frequency circuit, including the transistor, in the cubicle contents of a thimble. You understand from this why I am inclined to credit the statement that the transistor offers characteristics potentially superior to those of the vacuum tube for high frequency applications.

Now you are wondering whether you are going to receive diffusion transistors in your equipment to be delivered next week. The answer is most emphatically, "No"! The diffusion transistor is a laboratory device, and reasonably conservative estimates would indicate that large quantities of the new unit will not be available in less than two years. There will be experimental samples, of course, and probably some bugs in performance will develop, and a variety of difficulties must be resolved before we are equipped with a practical diffusion transistor unit which can be routed freely into our communications equipment. The important fact is that the major barrier to the frequency limitations of transistor design has been demolished. We have not been wrong in our optimism about the future of transistors. I believe that this semi-conductor field is the most progressively interesting area in the whole field of electronics.

The major interest always centers about the transistor because of its great versatility, but we should not overlook the development of power rectifying diodes and the perfection of the so-called "solar-battery." Diffusion techniques applied to both of these devices have produced remarkable units. Tiny silicon diodes provide the rectification needed for anything from Handie-Talkie Units to ¼-Kw. power transmitters. Transistor oscillators joined with silicon diodes will very probably eliminate the use of vibrator power packs in mobile receiver systems. In time, the power levels attained by this oscillator rectifier system will also eliminate motor generator and vibrator power units for mobile transmitters.

The solar battery is under production in quantity, but for a long time it will be extremely expensive. Someday, when you can afford to buy a square yard of this silicon device, you can use it to pick up 100 Watts from the sunshine to charge your storage batteries and to operate your remote and relay transmitter installations.

The present state of development in the mobile communications field has settled down to refinements of design, with the reliability improvement and maintenance cost reduction the major objectives. In the semiconductor art, we find a whole new area of challenge for our future mobile communications equipment. The real progress in mobile communications over the next decade will be derived from the application of the new semi-conductor devices.

The practical production of reliable transistorized mobile units may be years away, but our Motorola research engineers and scientists are busy preparing for the ultimate practical embodiment of advanced mobile equipment design. One of our closely kept secrets was our early work with transistorized mobile units. We have had mobile units working with transistors for more than four years. For the past two years, we have had mobile units in daily operation in a controlled Phoenix, Arizona research and test operation. We are always challenging the frontiers of design.

When we give you equipment with transistors incorporated in the design, it will be matured, conservatively engineered, reliable equipment. Transistorized mobile equipment is still a long way off. If we wait two years for the diffusion transistor, we may have an additional two years to wait for the equipment. A new art must have sufficient time to develop a practical degree of maturity.

Sincerely,

Dan Noble

The

Motorola Newsgram

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Technical Information Center

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The new very-high frequency diffused base transistor will be produced in substantial quantities by Motorola's million and one-half dollar plant nearing completion at Phoenix, Arizona.

Motorola Manufacturing New Diffused Base Transistor

Daniel E. Noble, Vice-President of Motorola Inc., Communications & Electronics Division, has announced that Motorola is manufacturing the new diffused base transistor. A pilot production line is producing the new very-high-frequency units in the Motorola-Phoenix, Arizona Research Laboratories.

This is a very significant announcement, Mr. Noble explained, opening up the use of transistors in all radio circuitry heretofore limited by frequency characteristics of transistors. The diffused base transistor technique permits the production of transistors working in frequency ranges as high as one thousand million cycles per second. Motorola is the first manufacturer to announce the development of production techniques which yield volume quantities of the component. While the alloy junction-type transistors, which are the type commonly in use, are excellent for audio frequency applications, only selected units of this type were suitable for application, even in the low radio frequency ranges. The diffused base transistor breaks this frequency limitation so that practical application of transistors to television, military equipment, and communications equipment of all kinds is now possible.

The diffused base transistor was originally developed by Dr. William Shockley and Dr. George Dacey, of the Bell Telephone Laboratories, but prior to Mr. Noble's announcement there had been no word of successful commercial production of the new device. The transistor produced by the Motorola technique is a new configuration of the basic Bell Laboratories' invention.

Mr. Noble stated that pilot production of this new device will continue to produce quantities sufficient for extensive laboratory circuitry exploration and devices development while preparations are going forward to develop semi-automatic means for the production of the diffused base transistor in very substantial quantities in Motorola's new 67,000 sq. ft. transistor plant at Phoenix. It is estimated that a minimum of one year will be required to make the transition from the successful pilot production into semi-automatic substantial mass production of the diffused base transistor. An additional one or two years may be required to fully incorporate the components into practicable, field tested and proved radio communications and industrial electronics equipment. » » »

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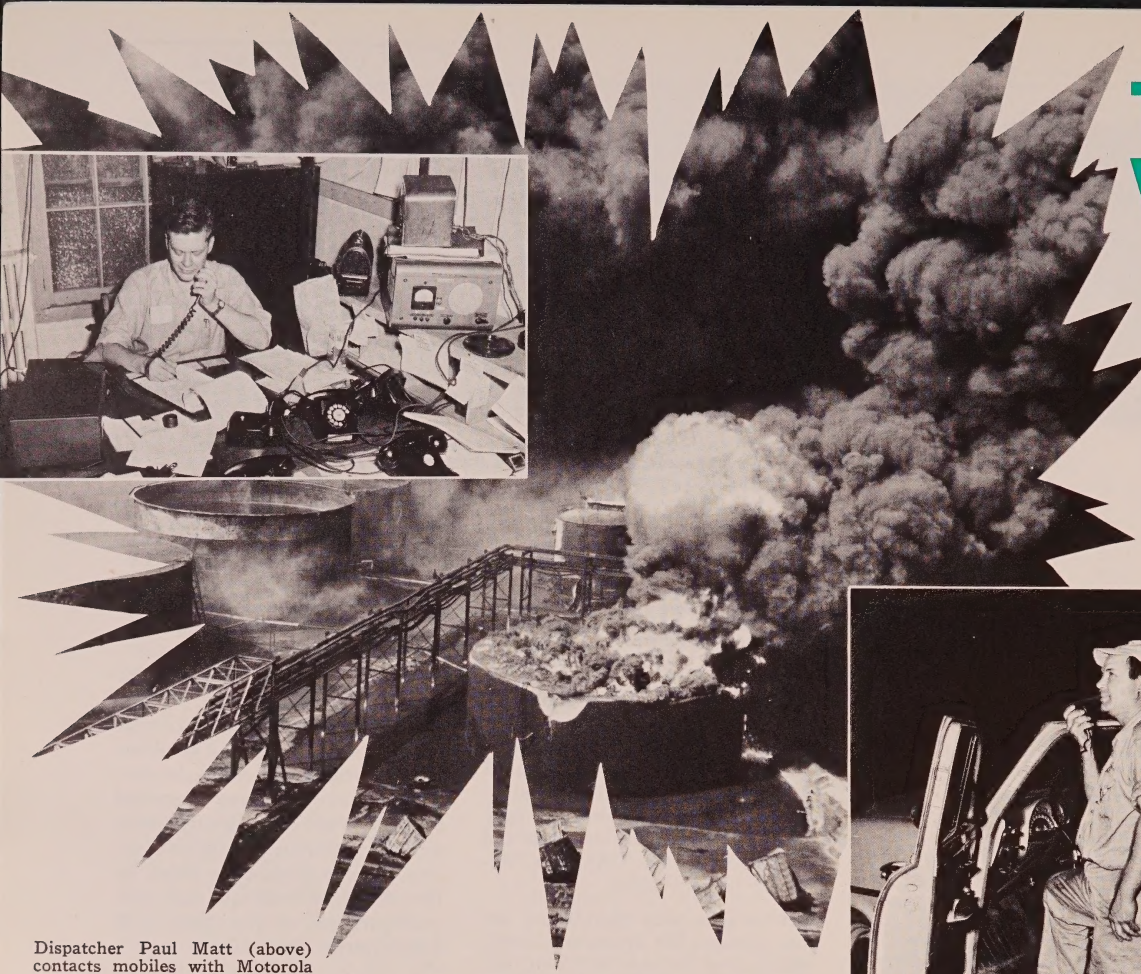
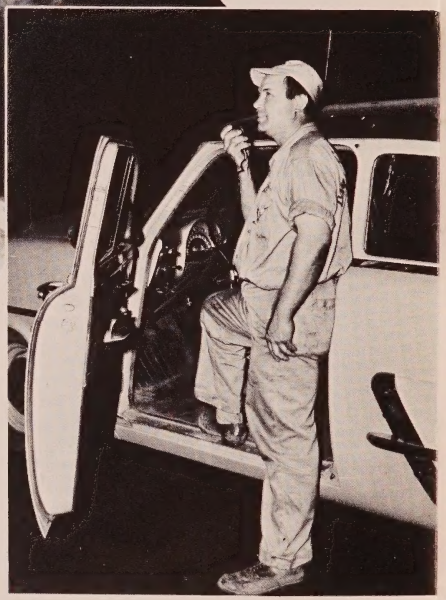




Dispatcher Paul Matt (above) contacts mobiles with Motorola auxiliary base station after plant-wide telephone failure knocked out remote control unit. Lowell Lundquist (right) and Ray Kramer of Southside Communications kept Standard's radio operating perfectly throughout disaster.

A Plan . . . a Corps . . . A Motorola Mobile Radio System — These Stopped the Raging Oil Fire After a Catalytic Cracking Unit Exploded at the Indiana Standard Refinery

On August 27 a high-octane gasoline hydroformer exploded at the Whiting refinery of Standard Oil Company of Indiana.

Within two days the spreading blaze consumed 70 petroleum storage tanks, and the damage climbed well beyond $10 million.

Yet, with the entire 1,500 acre refinery in extreme jeopardy and highly vulnerable to the incredibly intense heat, the fire was confined to a mere *10 acres.*

The company's forethought in anticipating just such a disaster is a prime reason for this fire-fighting success. The skillfully conceived emergency plan stood ready. And it worked perfectly when needed.

The know-how and sheer bravery of the company fire-fighting corps was another key factor. At great personal risk these men, all of them Standard Oil employees, threw up scores of sand dikes to contain the flaming, flooding oil that spilled from heat-buckled storage tanks. They dragged water hoses into the heart of the devastation to cool other tanks that threatened to collapse and ignite. And they moved men, trucks and foam equipment swiftly from one outbreak to another.

The big need was for sand—and plenty of it. Trucks from miles around brought loads to the refinery. Standard's radio-equipped trucks, stationed at gates and key points inside, gave each incoming sand truck its specific dumping destination. Other mobile radio units at vantage points reported the changing disaster situation to

ITING FIRE STORY

the fire marshal's office. Repeatedly, when oil broke loose or another tank caught fire, literally tons of sand were rushed in and dumped for diking in less than a minute's time.

All of this called for perfect timing by Standard's fire marshal, whose staff conducted minute-by-minute evaluations of the developing crisis. Out in the smoke-darkened refinery it called for complete flexibility of the corps to respond instantly to each new emergency. They achieved this vital teamwork because of 2-way radio communications, an everyday tool at Standard for materials handling and maintenance control, and plant protection.

Radio dispatching continued even after a telephone failure had knocked out the land-lines connecting the 250-watt base station with the five remote control points in the refinery. The fire had destroyed the main terminal block and every telephone in the refinery went dead.

Acting quickly, Ray Kramer, head of Southside Communications, the Motorola-authorized service organization, stationed mobile units at the fire marshal's office and other control points to take over base station functions. Kramer had full authority to do whatever was necessary to keep Standard's mobile radio system at peak efficiency.

His next move was to order three AC-operated 25-watt auxiliary base stations from Motorola Communications and Electronics Inc., in Chicago. As it has done many times during other emergencies throughout the country, the factory prepared equipment on a crash basis, adjusted it to Standard's Special Industrial frequency of 153.23 mc., and rushed it to Whiting within a matter of hours.

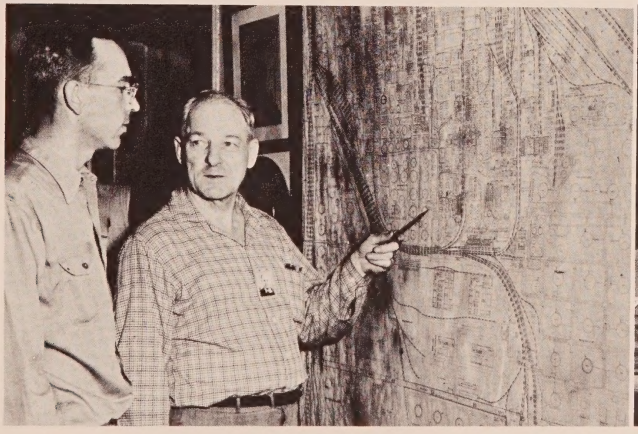
Three days later most of the storage tank fires had burned out and the rest were well under control. Clean-up operations began immediately. Twenty Motorola Pack Sets and five "Handie-Talkie" Radiophones which also had been rushed out by the factory were used to coordinate the work, since telephone service could not be restored throughout the plant for several weeks.

Today, Standard's mobile radio system is back at its regular daily job . . . a highly efficient communications tool whose value during a crisis has been proven anew, not only to Standard but to industry as a whole. » » »

Main Dispatching Point at Fire Marshal's office.

Right. One of Standard Oil's mobile units stationed near burning oil storage tank. Mobile radio units like these dispatched sand trucks and relayed emergency orders to firefighters.

Below. Dr. R. R. Wilson, Superintendent of Asphalt Division and Chairman of refinery fire committee points out initial explosion scene to Ray Kramer, head of Southside Communications.



Radio Enables Company to Save $10 A Day Per Truck By Cutting Wasted Mileage

Co-ordinating movements of 45 mixer trucks to take the output of five dispersed mixing plants has become almost a push-button operation for a Texas ready-mix concrete company, thanks to modern equipment and skillful methods planning. Fort Worth Sand & Gravel Company turns the trick with 2-way radio, shuttling trucks from one plant to another as the need varies.

Besides improving customer service, the new radio-control system is saving about 20 per cent in mileage per yard of delivered concrete. Dollar-wise, says Traffic Manager Weldon White, the radios save about $10 a day per truck.

The idea of diverting trucks from one suburban mixing plant to another is not new; however, under conventional communication set-ups the dispatcher has no way to notify drivers of a change in plans unless the drivers telephone in periodically. Between phone calls, no contact exists.

Fort Worth Sand & Gravel officials saw these telephone check-ins as needless waste of time. Getting to a phone was taking drivers out of their way and costing the company about an hour a day per man.

Now, with radio, drivers are "on call" at all times, both at the job and enroute to and from. Contact is instantaneous at the press of a microphone button by driver or fixed station operator.

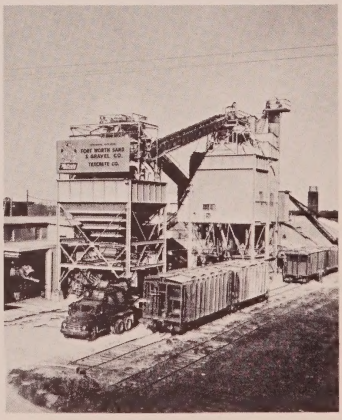
Here's how Fort Worth Sand & Gravel Company uses 2-way radio:

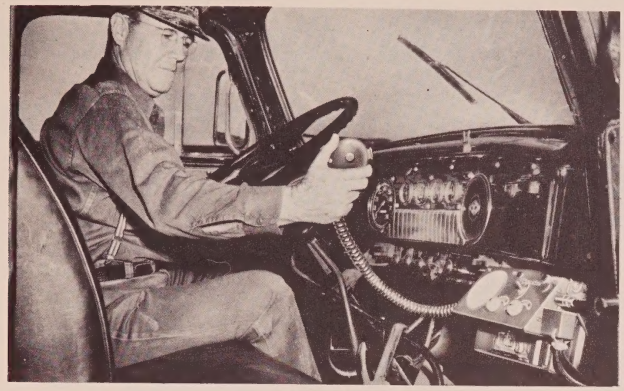
Hub of operations is the main office, situated at the eastern edge of the downtown business district. Here incoming orders for concrete are sorted according to the nearest mixing plant — Arlington, Hurst, Ridglea, West Side, or downtown. Trucks are dispatched to the various plants as needed.

At this point the "local" radio operator at each mixing plant (usually the plant superintendent) takes over control of his truck team, checking with the drivers as they progress through the pour. Drivers usually call in by radio each time they discharge a load.

At the completion of a job, the superintendent then gives drivers their next assignment—possibly another job at the same plant, or releasing the trucks to the central dispatcher for transfer to some other plant where they are needed. It is at this point the

General offices and plant of the Fort Worth Sand & Gravel Company.





Above, One-frequency radio system enables drivers to talk to the other trucks, supervisors and mixing plant operators.

Right, Coy Anderson, chief radio dispatcher, at remotely-controlled 60-watt base station in the company's headquarters.

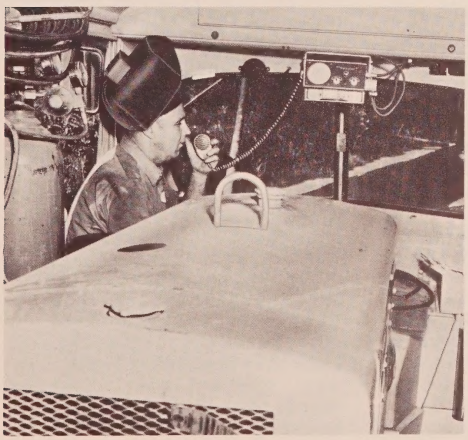
radios really save wasted miles. Working over a 900-square-mile county, it is not unusual to short-cut 10 to 12 miles per truck in this diversion, states M. A. Neal, chief dispatcher.

Radio contact is also helpful when drivers get lost or cannot locate a building site—a normal occurrence in newly laid-out subdivisions in which the streets may not be marked clearly.

Another way the radios help is freeing the large 6-yard trucks from the tag-end hauling when only a yard or two of concrete are needed to wind up the pour. After a driver radios the small-load information in, the dispatcher can send a 4-yard vehicle out to finish the job.

Often a contractor will make an error in estimating his needs. When this becomes apparent, the truck drivers can correct the order from the job site, raising or cutting the order in time to prevent overrun. Drivers also transmit requests to speed up or slow down the delivery rate to keep in step with the finishing crew, or to change the slump.

The new Motorola radio system is also proving a great boon in contacting the company's other cars and trucks, especially the emergency truck repair van. Mechanic J. A. Markham's specially-fitted mobile shop carries radio equipment identical with that in the mixers, and he can talk directly with a disabled truck, finding out the nature of the breakdown in time to pick up the required parts if necessary.



It is not unusual for mechanic J. A. Markham to be away from his headquarters several hours at a stretch answering half a dozen rush calls relayed to him in the field via two-way radio. Mobile repair van stores fan belts and other common parts, plus welding equipment and air compressor.

The rapid communication feature actually doubles the utility of the service van, believes R. P. McDaniel, truck superintendent. He states flatly: "One mechanic with radio can do the work of two men without radio. We would need another full-time man and another repair truck if Markham lost his radio."

Fort Worth Sand & Gravel also uses its mobile radio system to keep in touch with supervisors whose duties require considerable time on the streets. Soon after the trucks went on the air, 2-way sets were added in the auto of Production Manager Ray Thomas, in the pickup trucks of Glenn Chapman, in charge of concrete plants, and Howard Roland, in charge of company-operated gravel pits, and in McDaniel's car.

From an economic standpoint, the new radio system should pay for itself quickly through increased productivity and lower operating expenses, declares Vice President George A. Meihaus. As evidence, Meihaus disclosed figures showing his drivers traveled an average of 3 miles per yard of delivered concrete before using radio, but now have cut that to between 2¼ and 2½ miles per yard.

Little wonder George Meihaus is sold on 2-way radio, and says his concrete company wouldn't be without it now. » » »

PHOTOS Span Contin
Over Motorola

Among the observers in Chicago were A. L. Reese, national marketing manager for Motorola's C & E Division; Warren Bulla, supt. of operations for Texas Illinois Natural Gas Pipeline Company; Homer Marrs, Motorola's midwest regional sales manager; and C. E. Upson, general supt. of communications for Texas Illinois.

Pipeline successfully transmits maps, documents and photographs by facsimile process using standard voice circuits

Newspapers, magazines and TV have proved one fact over and over—pictures often tell a story better than words.

If the pictorial data are viewed at a distance from point of origin, the value increases. Add a need for rapid viewing, and the stage is set for facsimile, newest wizardry in the bag of electronic tricks.

Recently photographs, maps, drawings and other graphic matter have been successfully transmitted by microwave from the Great Lakes to the Gulf of Mexico.

The tests of facsimile transmission and recording were carried out over the private microwave relay system of the Texas Illinois Natural Gas Pipeline Company with excellent results. Copy sent over the 1,000-mile super high frequency radio circuit proved equal to or better than that which is transmitted over the best wire circuits engineered expressly for commercial telephoto service.

Co-operating with GAS Magazine, sponsor of the tests, and the pipeline company were Motorola and Acme Telectronix Division of NEA Service Inc., manufacturer of the facsimile termination equipment.

Facsimile transmitters and receivers were situated at the Texas Illinois general offices in Chicago's Civic Opera Building; at pipeline field operating headquarters in Malvern, Arkansas; and at Houston, headquarters for gas production. These sites were selected in an effort to simulate actual operating conditions where pipeline personnel would have need for graphic communication facilities.

In order to avoid disrupting any of the 12 microwave channels in regular use by Texas Illinois, a special temporary "Channel 7½" was inserted between the existing Channels 7 and 8. Multiplexing equipment from Motorola's new 24-channel microwave line was used, and proved sufficiently stable and selective to function without interfering with the adjacent channels.

Selected for transmission were sample logs, charts, and drawings which Texas Illinois department heads would normally exchange by mail. In addition, photographs were taken during the demonstration and transmitted to the other points on the facsimile circuit.

First day of the tests was devoted largely to the technical aspects of setting up the facsimile termination equipment, installing voice terminating equipment and sub-carrier transmitters from the 24-channel equipment. Most of the available test copy was transmitted on the first day. On the second day, the test material was edited to give the widest possible range of subject matter during the hours when the demonstration was open to guests.

Prior to the test transmissions, three identical sets of test copy were prepared and distributed among the three test sites, so that a direct comparison could be

ent Microwave

Spectators at Houston view a facsimile copy of the photo shown below.

made of original and facsimile recordings for detail and definition.

Except for minor problems caused by the temporary nature of the installations, no difficulty was encountered and the quality of recorded copy was perfect throughout the test.

Equally important in facsimile transmission is sufficient bandwidth to handle the signal and both sidebands. Lack of bandwidth would have resulted in loss of detail. Careful examination of the received copy showed no loss of detail beyond that normally expected in the scanning and recording processes. The high degree of definition retained in the received copy indicated the frequency response and phase differential of the microwave circuit were more than ample for facsimile, and considerably greater than that required for voice reception. Signal to noise ratio on the circuit was measured as better than 40 db.

A photo of Texas Illinois' microwave antenna at the Chicago terminal was among those transmitted.

Observers felt the two-day demonstration served several good purposes. Motorola and Acme engineers gained technical data on the signal handling capabilities of the microwave circuits as related to facsimile techniques. Visitors from the oil, gas and electric power industries viewed the tests in light of their operations, seeking those applications where the urgency factor in transmitting graphic material would make facsimile a wise investment.

Also, the facsimile-microwave link-up introduced new techniques to some widely different communications users. For example, elements of the newsphoto and press associations, newspaper and TV stations and the military which have had experience using telephoto and facsimile were exposed to the capabilities of 6,500-mc microwave; and large users of microwave—power utility and pipeline engineers—learned the latest developments in the field of facsimile.

The tests showed that long-distance facsimile transmission could be useful to the petroleum industry in these ways:

1. Rapid transmission of photos showing equipment failure in the field.
2. Gathering of payroll information for centralized accounting.
3. Verification of documents and signatures.
4. Accurate transmission of drilling reports, particularly those containing technical terminology which might not be familiar to office personnel taking oral reports.
5. Central examination of compressor engine performance cards.
6. Photos and reports of goods damaged in transit.
7. Centralized bookkeeping and billing where speed is a factor.
8. Rapid transmission of aerial patrol photographs, particularly those showing mining or construction activity on or near the pipeline, which might necessitate corrective action in the interest of safety. In such cases, immediate examination of the exact wording of agreements with landowners might be required, and copies of the land agreement could be exchanged via facsimile.
9. Transmission of orifice meter charts for purposes of analyzing water content, BTU or specific gravity, or operating conditions. Transmission of these charts for billing purposes is not recommended, due to legal limitations, however.

The two major advantages of facsimile as evidenced by the test were (1) the matter of urgency in getting graphic information from one point to another, and (2) elimination of errors in handling of words and figures by voice.

Commenting on the tests, Warren Bulla, superintendent of operations for Texas Illinois Natural Gas Pipeline Company, declared that the demonstration "was indicative of another step in the continuing trend toward use of automation in the gas industry."

Arthur L. Reese, national marketing manager for Motorola's Communications & Electronics Division, pointed out that Motorola is very interested in exploring graphic communication techniques, particularly as related to automatic control methods, and complimented all participants to the test for contributing to the pool of information on facsimile via microwave.

mobile radio. . . .

COMMUNICATIONS CUT CARTAGE COSTS

Could 2-way radio dispatching of its pickup and delivery trucks boost productivity and improve customer service? The Rochester Carting Company had seen this happen in many other companies in the transportation business . . . and decided to try.

Results: Excellent, with productivity up an average of 10 per cent and service markedly better. Appraisal of radio: Definitely here to stay.

Rochester Carting is one of the largest local carriers in upper New York State, serving as draymen for the New York Central Railroad on all less than carload freight pickups and deliveries in Rochester. In addition, the company headed by President Rudolph G. Weis operates a motor freight terminal which serves four common carriers. For two of these carriers—American Freightways Company of Brooklyn, and Rodgers Motor Lines, Inc., of Scranton, Pa.—the Rochester firm handles all pickup and delivery work in the area.

Late in October 1954 Rochester Carting equipped 12 straight trucks and 3 tractors with Motorola two-way radios, operating in the 460-megacycle Citizens Band. The main station transmitter and receiver are located atop the Lincoln-Rochester Trust Company Building in downtown Rochester, with the antenna about 270 feet above street level. Trucks enjoy good communication with the main station for distances exceeding 20 miles in all directions.

Chief Dispatcher Robert Banker operates the main station by remote control from the terminal at 25 N. Washington Street. On his worktable are the microphone and a small remote control consolette containing a loudspeaker. When he talks into the mike, his voice goes by wire line to the main station downtown, where it is transmitted by a high-gain antenna to all trucks. Voices of the answering truck drivers come back the same route—by radio from truck to main station receiver, then by wire line to the loudspeaker on the dispatcher's desk. Communication in either direction is instantaneous at the press of a button.

The trucks used in P&D service for the railroad and the motor carriers are best examples of how radio is used. Drivers are in constant contact with the nerve center, the dispatcher. When drivers pull away from the terminal or the freight station in the morning with deliveries, they start by reporting the weight and number of stops on their load. Upon completion of each stop the driver calls in and the dispatcher marks the stop number on the dispatch sheet in a space after the driver's name. This sheet is laid out by half-hour intervals across the sheet and tells exactly how the driver is progressing.

For morning pickups the driver who is in the area will often make pickups before he has completed his deliveries. This not only saves

Robert Banker, Chief Dispatcher, and Assistant Donald DeForge, consider Motorola 2-way radio an indispensible tool for the efficient handling of trucks.

Besides making his own work easier, Driver Robert Conklin likes 2-way radio because of the new spirit of teamwork it has instilled in all the drivers.

time for the driver, but satisfies the customer by getting his freight before the afternoon rush. When a driver finds that he is going to be delayed because of congested traffic or has a question concerning his shipment, he just calls the dispatcher for instructions. There is no need to bother the shipper and tie up his telephone or look for a place to park and find a coin telephone.

After all deliveries are completed, pickups are given to the driver and he reports his progress both as to stops and the amount of space left on his truck as he proceeds. If a driver needs assistance, he calls the dispatcher and asks for help. Usually the dispatcher can contact another Rochester Carting rig in the immediate area and assistance arrives in a matter of minutes.

In this matter of assistance, the "party-line" aspect of the radio has proven quite useful. Often a pickup order will be radioed to a truck and another truck will be passing the dock of the plant where the pickup is to be made. If the second driver has room on his truck, he often will call in with "I'll make that pickup, I'm there now."

Calls often come in to the dispatcher late in the afternoon for an urgent pickup. While the shipper waits on the telephone, the dispatcher is able to radio to the trucks working in that sector and find out if the driver can make the stop. This kind of personalized service greatly pleases the customers, needless to say.

While mileage in a local operation is not a big factor, time is of the essence. With radio dispatching there is no back-tracking to eat up extra time. Pickups come in and they are given to the drivers in the vicinity of the shipper. The dispatcher does not have to call several plants before he locates a driver to handle an unscheduled pickup.

Another facet of Rochester Carting's operations is its three large warehouses devoted entirely to merchandise storage, operated through a subsidiary, Rochester Storage Warehouses, Inc. The radio system finds its uses in this service, too. Distribution deliveries are speeded up by radio because there is no indecision on the drivers' part as to whether to wait at a customer's dock while other trucks unload. The dispatcher makes the decisions.

In addition to handling all LCL cartage for the N. Y. Central R. R. (freight house above), Rochester Carting Co. serves four common carriers. Two-way radio dispatching has greatly improved its overall service.

Also, drivers are trained to radio in for further information whenever needed, and to report overages, shortages or damage. Rochester drivers make good use of their mobile radios to report OS&D matters, collection problems and credit inquiries.

Other carriers pondering the switchover to radio control may wonder how the Rochester drivers and dispatcher "took to" radio. According to William C. Warren, III, treasurer, drivers accepted the new tool quickly and like it very much. As an example, the fact that all drivers can hear everything the dispatcher says to any man has developed a new esprit de corps among them—they now feel that they are members of a team, and they are proud of it. Their attitude is reflected in the way they help each other out all day long.

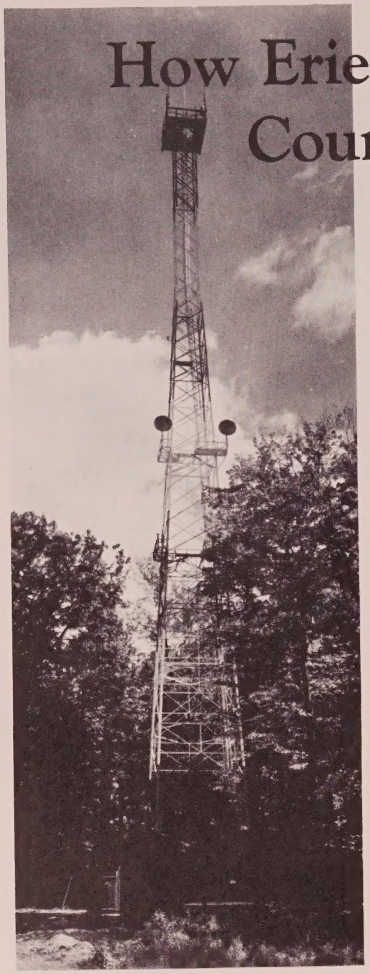
As for the dispatcher, Warren says Chief Dispatcher Banker has long since lost any doubts he may have felt about the value of radio. "In fact, I'm sure he'd threaten to leave us if we ever said we might remove the radios," Warren adds.

Rochester officials, including President Weis, Treasurer Warren, and General Manager Richard H. Powell, worked closely with the radio manufacturer's representative in getting the system installed and operating smoothly. In fact, the Motorola radio communication specialist assisted greatly in negotiating for the downtown main station and antenna site, leasing the connecting wire lines and obtaining the required license from the Federal Communications Commission. In addition, the Motorola engineer worked with the dispatcher and drivers, holding meetings at which the equipment was demonstrated and its uses shown.

After a three-months period, top officials of Rochester Carting Company are well satisfied with the radio control system. They notice a definite increase in the productivity of weight and stops handled by their drivers.

To sum it up, they believe radio is well worth the money.

How Erie County N.Y. Coordinates County-Wide Mutual Fire Aid



Unique 200-foot tower at the remote county-wide transmitter site has a platform on top for ease in installing and maintaining antennas. Parabolic reflectors midway on tower are for radio relay equipment interconnecting the location and the master control console in Buffalo.

In 1950 a county-wide mutual aid fire system was organized to coordinate the activities of 96 volunteer fire companies scattered over 1000 square miles of Erie County with the activities of the Buffalo, Lackawanna and Tonawanda city fire departments. Although this program was an improvement, major weaknesses were soon revealed, all of which were traced to one factor—poor communications.

When a volunteer fire-fighting unit went to help a neighboring community, it was "lost" so far as its own community was concerned.

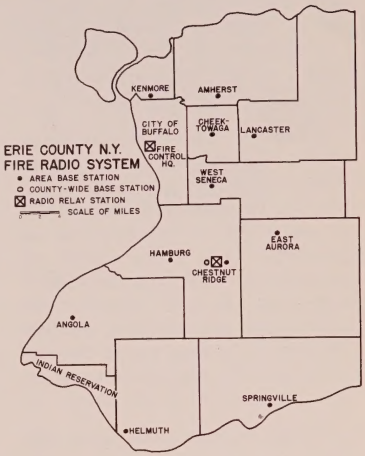
When a volunteer fire-fighting unit arrived at a fire and decided that more help was needed, time was wasted in getting to a phone and calling for more help.

During the dry summer months when water tank trucks had to be positioned in high areas where water pressure was low, other areas were often left with inadequate protection.

In the event of a major emergency there was still no means of coordinating the activities of all the fire-fighting units in Erie County.

Even though the Buffalo Fire Department was radio-equipped, its transmitter was located in town and would probably be disabled by an air attack.

The solution was obvious. A 2-way radio system was needed for the 96 volunteer fire companies

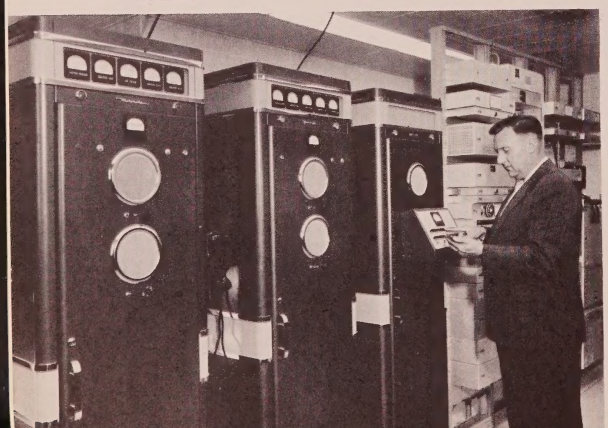


and control of this system should be possible from the same control center as that of the Buffalo fire radio system. When the Federal Civil Defense Administration approved the proposal to provide half of the funds required for such a radio system, specific planning began.

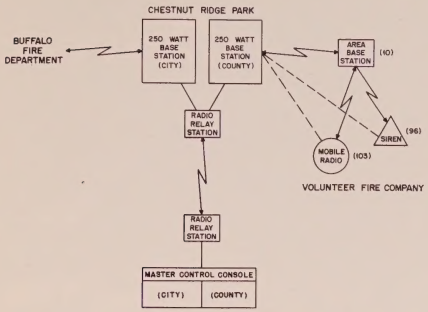
The size and complexity of the proposed system required professional radio-engineering counsel. Erie County was fortunate to secure Mr. Nicholas J. Reinhardt from the New York City Fire Department as a consulting engineer. His knowledge and experience were invaluable in designing the system and preparing the specifications.

On the basis of exhaustive tests, Motorola equipment was selected. In approximately one year the system, costing $420,000, was completed. It provides a dual radio control console at the Buffalo headquarters which permits independent control of the Buffalo fire radio system and the county volunteer radio system, or coordination of all units.

The master control console in Buffalo is connected by a radio relay system to two 250-watt transmitters (one for the city and one for the county) at a remote site (Chestnut Ridge Park) 15



Joseph A. Fahrner, supervisor of the county portion of the Erie County fire radio system, presses a button on the Motorola "Quik-Call" box at the Chestnut Ridge transmitter location to test a radio-operated siren. The 250-watt base stations for the city and county fire systems are shown in the foreground with radio relay equipment in the background.



One master control console is used to operate both the Buffalo fire radio system and the county volunteer radio system.

miles from Buffalo. All the radio equipment, including spare 250-watt transmitters, is in an unattended building beneath a 200-foot tower which provides county-wide radio coverage. The city part of the master control console is also connected to two additional transmitters and three additional receivers at different locations in the Buffalo area. Any transmitter and receiver can be selected by depressing the associated key on the control console.

Rows of indicator lights on the master control console report on conditions at the unattended building including: tower lights (on or off), room temperature (normal or abnormal), burglar alarm (door open or closed), standby gasoline power-generator (off or running), and level of fuel for the generator (normal or below normal). Abnormal conditions are automatically alarmed by both visual and audible signals.

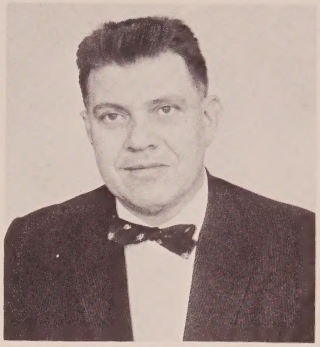
The master control console is set up so that city and county base stations can be inter-connected to enable city and county vehicles (on different frequencies) to talk to each other. This is accomplished by dialing the proper number at the console.

For purposes of control, Erie County is divided into ten areas, each having a 60-watt base station to communicate with radio-equipped fire trucks of volunteer fire companies in its area. Each area base station has a stand-by power generator, many of which are also used to supply emergency power for important community operations such as hospitals and police stations. Although the county-wide 250-watt base station at Chestnut Ridge Park usually communicates with just the area base stations, it can also contact directly all volunteer fire companies.

The dispatcher at either the area base station or the main control console can select and actuate any of the radio-operated sirens, which are located at each of the 96 volunteer fire companies, by merely pressing an associated button.

Each button of the Motorola "Quik-Call" equipment transmits a combination of ultra-stable musical tones through the radio system. Each combination of tones actuates a tone decoder, and in turn, a siren at a specific location. Multiple tone combinations are used to provide maximum reliability of operation and maximum security against false operation even in the presence of excessive noise and interfering signals. By pressing a special "group" button, the dispatcher can operate all sirens at once.

Fire-fighting activities are normally coordinated from the area base stations, which are attended



Nicholas J. Reinhardt, consulting engineer on Erie County Fire Radio System.

24 hours a day. In extreme emergencies, such as a Civil Defense disaster, coordination would be accomplished from the main control console in Buffalo, or from the remote transmitter site if the master control console was disabled.

One volunteer fire company has completed installation of selectively called Motorola "monitor" receivers in the homes of firemen. This eliminates the necessity of sounding the community siren which usually results in a flood of calls that tie up the local telephone system, and crowds of curious people that hamper operations at the fire scene. The receivers also enable special groups of firemen to be called for first aid and small fires, when all men and equipment are not needed.

"This fire radio system is the most profitable investment the county could make," said Harold R. Becker, Fire Coordinator of Erie County. "It will save many times its orginal cost in savings of time, property and lives of the people of Erie County."

Harold R. Becker, Fire Coordinator of Erie County, New York (right) and Eugene S. Goebel, National Sales Manager of Motorola Communications & Electronics Inc., at the main control console of the new county-wide fire radio system.

Shilling's Carhops Use Motorola "Handie-Micro-Talkie" Radio Transmitter System to Rush Food Service

Below, carhop comes to counter to get food in response to outside signal light which goes on when cook puts customer's check under specially-designed clip-switch. Light goes out automatically when check is pulled out . . . goes on again when check for next pickup is inserted under clip.

Talk about smooth operations, Shilling's Drive-in Restaurant takes the cake. Actually, they don't serve a great deal of cake, but they do a whopping volume in malts, shakes, hamburgers and whatever else a growing horde of steady customers in the Fort Wright, Kentucky area demands.

The thing that Shilling's does that astounds its customers is place customers' orders by radio . . . direct to the kitchen. Owners Clifford Robertson and Arthur Mueller have equipped their carhops with Motorola "Handie-Micro-Talkie" radio transmitters, which are small, handsized units that are giving Shilling's a wide reputation for ultra-prompt service. One of the first drive-ins to employ two-way radio, Schillings is licensed under the F.C.C. Low Power Industrial Radio Service. Here's how the system works:

Carhop gets order from customer and, using her radio transmitter instead of an order pad, transmits it direct to the kitchen. The carhop's voice is received on a monitor receiver and is written on an order pad by a central order writer, who passes it in to the kitchen.

When the food is ready the cook puts the check under a clip type switch on the pickup counter, thus breaking an electrical contact and flashing a colored light signal outside. When she sees her light go on

Restaurant ORDERS VIA RADIO

the carhop knows the order is ready, and picks it up.

This simple, foolproof radio system has greatly speeded up carhop service at Shilling's 72-car lot. Carhops no longer have to write, which makes ordering faster and also greatly reduces mistakes. When she has taken one car's order and has radioed it in, the carhop can immediately go to another customer, instead of making a trip in to relay the order personally to the kitchen. When the first order is ready the carhop knows it because she keeps watching her signal light, which shows up at three plainly visible locations in the lot. A girl can spot her signal without interrupting an ordering conference with the customer.

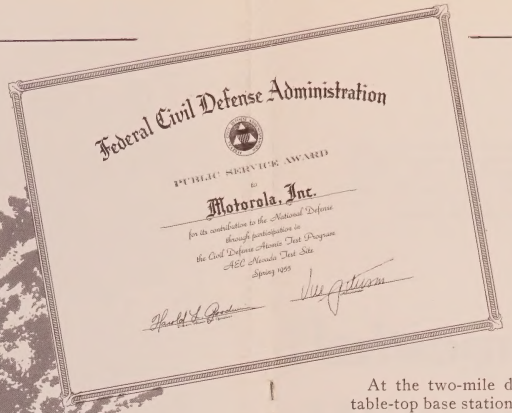
In these and many other ways, Shilling's new Motorola radio ordering system is proving to be a sound investment. » » »

Above, quick, efficient service—the kind that builds repeat business and then enables the same number of carhops to properly service the bigger volume—results from a single, fast round-trip . . . from car to kitchen and return. Ordering by radio means that carhops have more time to do a good selling job, get bigger orders, and are even likely to better on tips. The Motorola "Handie-Micro-Talkie" radio transmitter slips into a belt case while carhop is serving the customer's food.

Carhops at Shilling's don't carry order pads, they carry one of these small Motorola "Handie-Micro-Talkie" radio transmitters. The customer's order is flashed to the kitchen via the airwaves using the unit as shown. This unique ordering procedure not only is fascinating to customers, but builds a reputation for excellent service.

Below, the order comes into the kitchen through this Motorola Monitor Receiver located by the car service pick-up counter. Here the central order operator writes the order down on the check and places the check in the appropriate rack for filling by the food preparation departments. A flip of a switch in one direction signals a carhop to "hold" her order if the operator is already taking another order from another carhop. A flip of the switch in the other direction signals the waiting carhop that the channel is clear and to "go ahead".

RADIOS SURVIVE ATOMIC BLAST



America's vital lifeline of radio communications will survive an atomic attack, declare observers of "Operation Cue," the civil defense phase of the May 5 atomic detonation at the Atomic Energy Commission's Nevada Test site.

Two-way radio equipment stood up under terrific heat, pressure and shock — even demolition of brick buildings — and continued to function perfectly, reports Carl G. Tinsley of Motorola, Inc.

The experiments took place under auspices of the Federal Civil Defense Administration to learn how well two-way mobile radio systems could withstand an enemy's atomic assault. Participants included member companies of the Radio-Electronics-Television Manufacturers Association.

Particularly notable was the durability of a Motorola transmitter-receiver in an automobile at 4,700 feet from Ground Zero. Reports Tinsley: "The car had all windows knocked out, roof caved in, trunk lid blown into a vertical position and the paint blistered. Radio was undamaged, however, and immediate contact was made with the base station. No repairs necessary."

Radios were placed at 4,700 feet and 10,500 feet from the center of the blast. Identical equipment was tested at both positions.

At the two-mile distance, the Motorola 30-watt table-top base station and the "Handie-Talkie" portable radiophone in the bedroom of the test building were unscratched, although the room was showered with broken window glass.

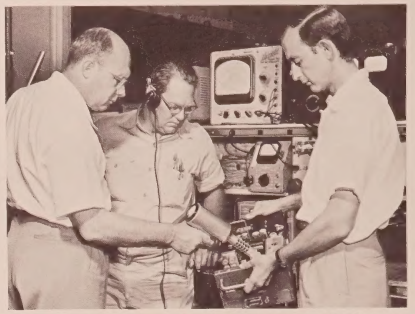
Near by, the two associated test antennas — a Triple-Skirt coaxial radiator and an Isoplane quarter-wave vertical with dual ground plane and isolating elements — stood the blast without harm. Communication was possible immediately when electric power was restored.

A radio-equipped 1950 Plymouth auto was damaged slightly at the two-mile range.

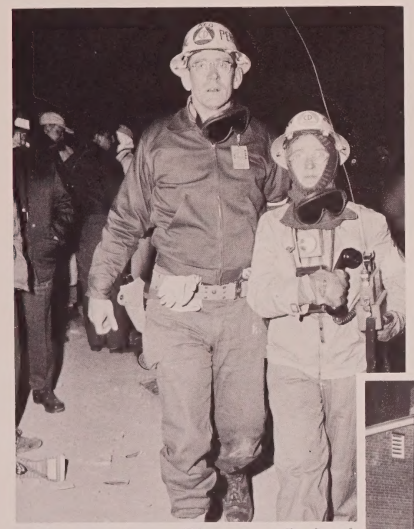
At the .9-mile line the effects of the blast were much more noticeable. Here the Model FSTRU-80BY base station and the battery-powered portable radiophone were tested in the basement of a two-story brick building, with test antennas mounted on an unguyed tower 150 feet away.

The nuclear explosion completely collapsed the building; however, the first floor did not fall in, and the radio station itself was not damaged. Test antennas were lost when the tower snapped off 40 feet above ground, breaking the antenna transmission cable. A temporary antenna in the basement was connected for test performance and showed the radio station to be in excellent working order.

Results of the atomic test program were hailed by communication specialists as demonstrating the rugged design of modern two-way radio equipment. Thousands of units similar to those tested are now in use by fire and police departments, railroads, taxicabs, power utility companies and industries in every sector of this country and Canada. Reliability of communications is considered extremely important to Civil Defense in case of disaster or enemy attack.



Carl Tinsley, Motorola development engineer, holds a mobile radio that was exposed to the atomic explosion, while Dr. Virgil E. Bottom, director of research and development at Motorola's Transistor Plant in Phoenix, checks it for radioactivity with a geiger counter. Listening for the clicks that denote radioactivity is Eugene Skelly, construction engineer, in whose truck the unit was about to be installed. Unit was in excellent working order and was perfectly safe to use.

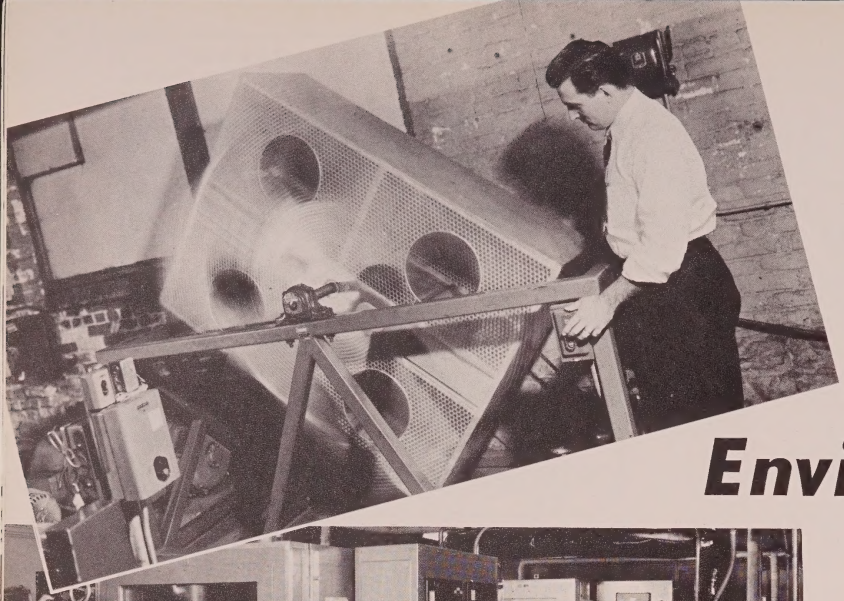


Adverse weather conditions repeatedly forced continued postponement of "Operation Cue." Here, Civilian Defense workers taking part in the tests leave the site of the scheduled test after it was postponed for the second day in a row. Shown are Wilbur M. Meyer, Reading, Pa., and Lois Hazell, Chevy Chase, Md., who is carrying a Motorola "Handie-Talkie" portable radiophone. (United Press)

BEFORE: A two-story brick house and two radio-equipped cabs are situated 4700 feet from Ground Zero. In the basement of the building was a base station unit and a portable radiophone.

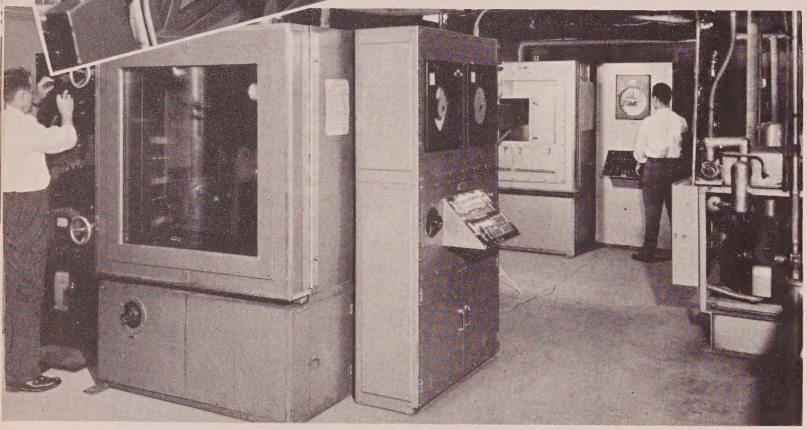
AFTER: Minutes later the house had completely collapsed and the cars were severely damaged. But the mobile radio came through undamaged and immediate contact was made with the base station.

AFTER: Civil Defense rescue crews utilize Motorola "Handie-Talkie" portable radiophones while evaluating the effects of the blast.



TUMBLE TESTER: Within its four compartments, meters or relays suitably encased are tumbled for 45 minutes to determine how well they will stand up under rough treatment. Machine rotates at a speed of 5 RPM.

Environmental for the



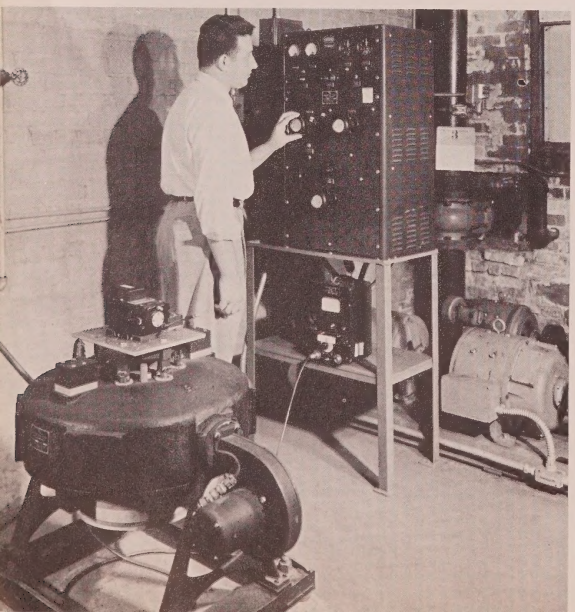
HUMIDITY CHAMBERS: Automatic recording controls permit cycling of temperature and humidity for periods of 24, 48 or 96 hours in these humidity chambers. Temperature range is 37 to 175°F; humidity range 20 to 95%. Chamber at rear has special insulated doors built by Motorola engineers to facilitate inspection and insertion of materials.

How well will a piece of electronic equipment operate at the extreme altitudes reached by jets and missiles? What will be the effect of high and low temperatures, pressures, and humidities, of corrosive atmospheres, vibration, shock, and other extremes in environment.

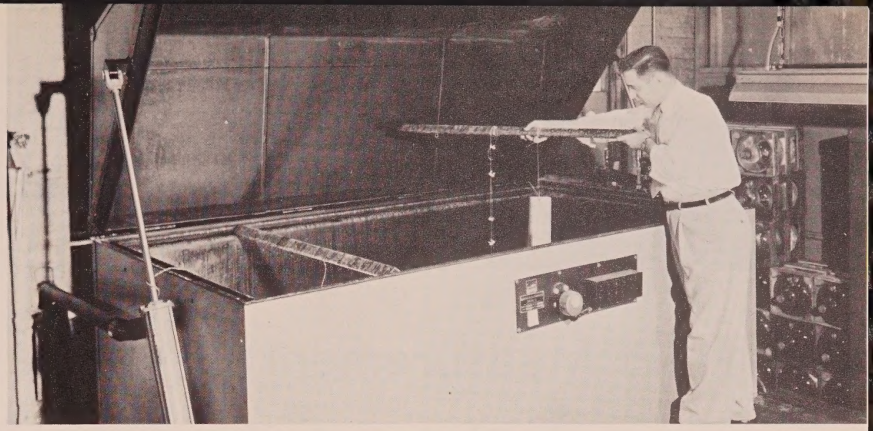
Military equipment *must be designed* to operate at such environmental extremes, and component qualification is a logical prerequisite for reliable operation of the completed equipment. For this reason Motorola's Incoming Quality Control Department at the Clybourn Ave. (Chicago) plant includes a large, well-equipped environmental test laboratory that has been surveyed and inspected by the Signal Corps Laboratory, and is officially approved to certify components. It is used for pre-production component sample approval, continuing production inspection and for type testing of complete equipments.

Component test conditions are established by the various military agencies, which have generally standardized on specifications of common items.

Thus far, Motorola has had equip-

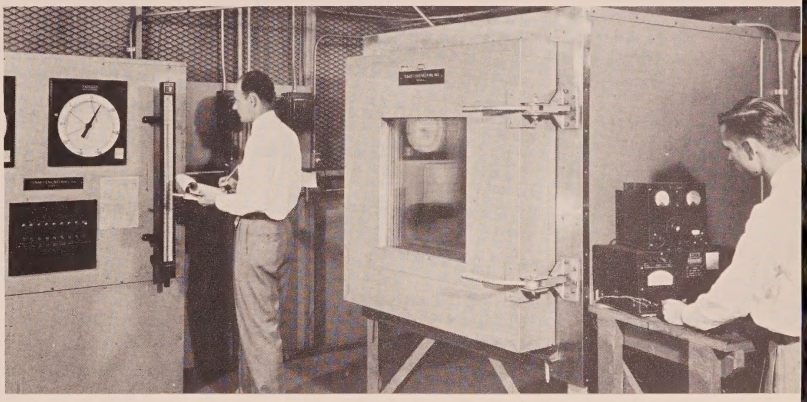


VIBRATION MACHINE: Operating within a controlled frequency range of 3 to 500 cps, this high frequency vibration table is usually used with an accelerating force of 5 to 10 G's, and has a maximum amplitude of 1".



SALT FOG CHAMBER: Practically all types of mechanical elements and coatings are sprayed with a salt solution in this 4′ x 4′ x 8′ chamber to determine the resistance of coatings and coated parts to corrosion.

Testing Military

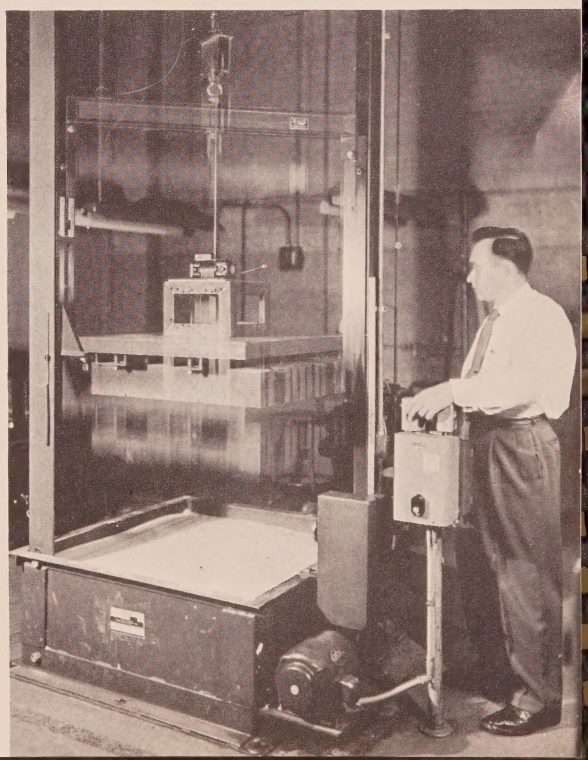


STRATO-CHAMBER: A fully instrumented Strato-Chamber "carries" components and equipment up to an altitude of 75,000 feet. Temperatures can be varied from —100 to +200°F, humidity up to 95%.

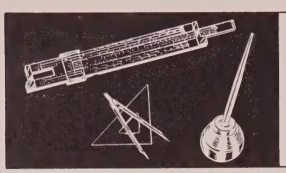
ment in production requiring tests for operation at ambient temperatures ranging from —40°C to 125°C, relative humidities up to 95%, and altitudes up to 75,000 feet. Components have been subjected to shock tests involving forces 75 times that of gravity and to vibration tests up to 1000 cps. Commercial Communications equipment produced for industrial and public safety users is subjected to all environmental tests pertinent to those services.

Parts such as transformers have been put under life tests ranging up to 2000 hours of continuous operation. Other parts such as relays and motors are subjected to start and stop operations. Relays have been tested for up to 10,000,000 operations, dynamotors for 10,000 starts.

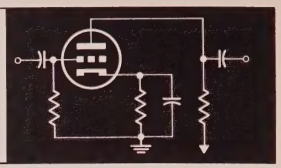
Special environmental test equipment, some of which is pictured here, includes humidity chambers, ovens, an ozone chamber, a potentiometer life tester, a rotary switch life tester, a salt fog chamber, shock machines, a strato-chamber, a tumbling machine, and vibration machines. » » »



SHOCK MACHINE: Parts and components are subjected to a force up to 80 times that of gravity when placed on the table of this machine and allowed to drop into the box of sand below.



Technical Notes Section



Field Measurement of Ambient RF Noise

RF noise can decrease the operating sensitivity and, therefore, the communications range of a receiver. It is good practice to measure the effect of RF noise in an area on receiver sensitivity so that this factor can be considered in determining the expected communications area coverage.

RF noise is usually present in the vicinity of cities, well traveled highways, high voltage power lines, electrical power substations and generating plants, high-power broadcast transmitters, factories, hospitals and doctors offices where diathermy equipment is used. However, so-called "open country" is often deceiving and can also have a high noise level. RF noise generally occurs in greater intensity in the 25-54 megacycle range than in the 144-174 and 450-470 megacycle ranges.

OPERATING RECEIVER SENSITIVITY

The actual operating sensitivity of a receiver in the presence of ambient noise can be determined by the following procedure. An AC vacuum tube voltmeter is connected across the audio output leads (which are terminated with a standard speaker) and the receiver volume is adjusted for about 1.5 volts of audio output as indicated by the VTVM. A signal generator on the receiver frequency is connected to the antenna input through the 6 db. pad of the signal generator, and the receiver antenna input stage is trimmed for a maximum meter indication with a portable test set on position #1 or #2. The output of the signal generator is then adjusted to obtain 1/10 the previous receiver output (VTVM) indication. The microvolts at the receiver input terminal are indicated on the 6 db. scale of the signal generator and constitute the standard "20 db. quieting" sensitivity of the receiver. This reading shall be referred to as "A."

The setup is then changed to that shown in Figure 1. The signal generator is connected to the receiver antenna circuit through the "T" connector which has the male pin removed to provide about 70 db. isolation (the male pin can be unscrewed with a pair of pliers). The 50 ohm dummy load is connected to the "T" as shown, the receiver antenna input stage is re-trimmed, and the signal generator output is adjusted for 20 db. quieting (about 2000 microvolts) as above. The generator output shall be referred to as "B."

The dummy load is removed, the antenna cable is connected, the receiver antenna input circuit is re-trimmed, and the signal generator output is again adjusted for 20 db. quieting. The generator output shall be referred to as "C." The receiver "20 db. quieting" sensitivity in the presence of the ambient RF noise is then calculated as "A" x $\frac{\text{"C"}}{\text{"B"}}$ (microvolts).

CALIBRATED RECEIVER METHOD

A calibrated receiver can be used to make a fairly representative field survey of ambient noise. A graph is plotted of portable test set position #1 and #2 meter readings versus microvolts input from a signal generator. If a portable test set is not available, metering leads can be connected to chassis ground and pin 1 or 2 of the metering plug on the receiver. A meter with a 50 microampere full scale movement can be used, but an 18,000 ohm resistor must be placed in series with the metering leads. The leads should have a well grounded shield to avoid a feedback or capacitive condition which would affect sensitivity. Position #1 and #2 meter readings observed in the field can then be converted to equivalent microvolts input for evaluation of ambient noise conditions.

Test set position #1 and #2 metering readings should be recorded for signal generator inputs of zero, ½, 1, 2, 4, 10, 30, 100, 300, 1000, 3000 microvolts and on up to the maximum output of the generator. The frequency of the signal generator should be adjusted several megacycles away from the receiver frequency for the "zero input" condition to preclude any leakage through the generator attenuator.

PRECAUTIONS

The battery voltage or receiver B+ voltage should be recorded at the time the receiver is calibrated, and checked during field measurements to make sure it

remains relatively constant. If field measurements will be made with the receiver in an automobile, the engine should be run at the same speed during the calibration as it will be run during the field measurements to get approximately the same battery voltage both times. If this is not practical, a curve should be plotted with the motor shut off, and another curve plotted with the motor adjusted for the maximum charging rate. The difference between these two curves can then be used as a factor in evaluating the field measurements. Any appreciable difference in the two curves is probably caused by excessive ignition noise voltage radiation (which should be suppressed) or a bad battery.

Since some signal generators shift in frequency when the output is changed, the test set position #4 meter reading (discriminator) should be checked from time to time to make sure it remains zero. The receiver antenna input stage should be trimmed when the signal generator is connected.

HIGH LOCATIONS

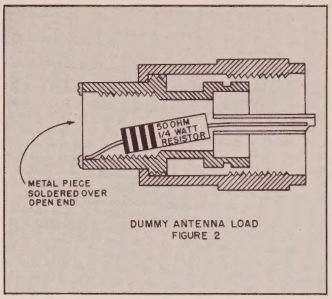
Surveying an area with the receiver in an automobile is not always an accurate indication, particularly in cities, of ambient noise at anticipated antenna locations 100 to 300 feet above the ground. If possible, a check should be made at the specific location. A portable antenna and a battery-powered receiver, or an AC-powered receiver and extension power cord can be used at accessible locations such as the tops of buildings.

PORTABLE ANTENNA

A portable test antenna can be constructed for this application by mounting a mobile whip, cut to the correct frequency, on a small piece of metal about one foot square and connecting four equally spaced ground radials (whip antennas or copper wire), each about 3/10 of a wave length long, to the base plate.

UNCALIBRATED RECEIVER

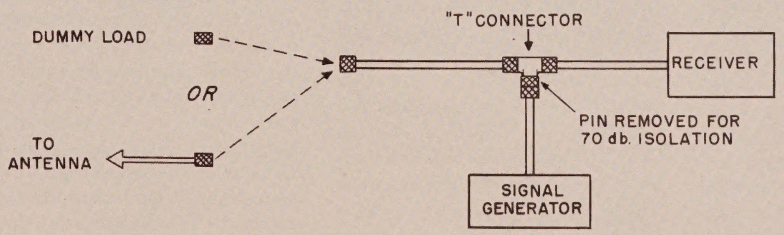
If a signal generator is not available, an uncalibrated receiver can be used to get a qualitative indication of ambient noise in an area. Test set positions #1 and #2 meter readings are observed with no signal received and the standard antenna connected. The antenna is then disconnected and meter readings are observed with the dummy load connected to the antenna input connector. The difference in meter readings is generally indicative of ambient noise. A general idea of ambient noise in relation to desired signal strength in an area can also be obtained by observing the difference between test set meter readings when a carrier from a distant transmitter is turned on and off. However, results from either of these two methods cannot be accurately evaluated because there is no correlation between the meter readings and the ambient noise.



DUMMY ANTENNA LOAD
FIGURE 2

EVALUATION OF DATA

There is no general "figure of merit" for data obtained from any of these measurement techniques since requirements vary with each system under consideration. The terrain, location of base station antennas, frequency used, and power radiated are a few of the factors which, together with operating receiver sensitivity, determine the communications area coverage to be expected. » » »



A = MICROVOLTS FOR 20db. QUIETING WITH SIGNAL GENERATOR CONNECTED DIRECTLY TO RCVR. THRU 6 db. PAD IN GEN. OUTPUT.

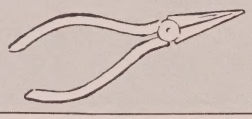
B = MICROVOLTS FOR 20db. QUIETING WITH DUMMY LOAD CONNECTED AS SHOWN.

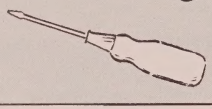
C = MICROVOLTS FOR 20 db. QUIETING WITH ANTENNA CONNECTED AS SHOWN.

EFFECTIVE RECEIVER SENSITIVITY = $A \times \frac{C}{B}$ MICROVOLTS.

FIGURE 1

SERVICE HINTS and SHOP NOTES





MOBILE MAINTENANCE SHOP RULES

The Federal Communications Commission, in response to a recent inquiry from a radio and television service firm, spelled out the license requirements for operating a mobile radiotelephone maintenance shop.

The Commission stated that "All transmitter adjustments or tests during or coincident with the installation, servicing or maintenance of a radio station, shall be made under the immediate supervision and responsibility of a person holding a first or second class radio operator license, either radiotelephone or radiotelegraph, who shall be responsible for the proper functioning of the station equipment. Provided, however, that only persons holding a first or second class commercial radiotelegraph operator license shall perform such functions at radiotelegraph stations transmitting by any type of Morse Code."

The letter went on to state: "Properly designed dummy antennas that do not radiate may be used in the service shop for testing and adjusting transmitters without a station license. Licensed transmitters may be tested and adjusted at the location stated on the station license or in the licensee's mobile units using their regular call signs if all adjustments are made by a person holding the appropriate commercial radio operator license . . . If, however, you propose to install a two-way radiocommunication system in connection with your business," the Commission said, "it appears that eligibility might be established in one of three services" — special industrial, low power industrial or citizens.

VOLTAGE REGULATORS

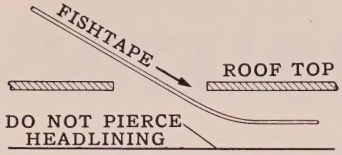
A properly adjusted battery voltage regulator is necessary not only for protection of the car battery but also to provide for efficient operation of mobile radio equipment. Any misadjustment which might cause higher than normal voltage readings at the battery will be reflected in substantially shorter tube life in the transmitter and receiver. This is brought about through exposure of the filament circuits to excessively high voltages. When the regulator is set too high the high heater temperatures resulting from the high filament voltages can cause grid emissions in the transmitter and receiver with consequent failure of transmission and reception. It will also shorten tube life and cause an unnecessarily high rate of replacement.

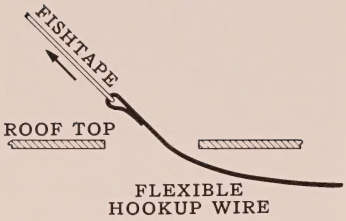
Any adjustments necessary should be made in accordance with the car or generator manufacturer's specifications. With normal regulator setting, the voltage at the battery will be from 6.9 to 7.3 volts for 6-volt operation, and from 13.8 to 14.6 volts for 12-volt operation. The voltage at the battery should never exceed a maximum of 7.5 volts on 6-volt vehicles, or 15 volts on 12-volt vehicles. However, if the larger cable used for 6-volt vehicles is used in 12-volt vehicles, the maximum voltage at the battery may not exceed 14.6 volts. The lower voltage drop in the larger cable will tend to raise the voltage at the radio set.

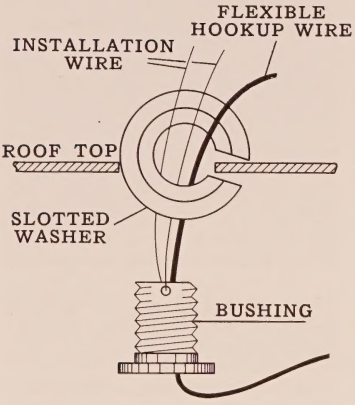
When making adjustments it is well to remember that the limits actually held by the regulator are dependent upon the temperature of the regulator, and it is important to control this temperature while checking and adjusting. A voltage regulator tends to hold a lower voltage limit while cold and a higher limit when hot. Therefore, make all regular checks and adjustments at "operating temperature", with the cover on the regulator, in order to avoid excessive cooling of the temperature-compensating elements in the unit. Never make adjustments until the regulator has warmed up for 15 minutes or more and be careful not to exceed the maximum limits of 7.5 volts at the battery for 6-volt operation and 15 volts at the battery for 12-volt operation. When using the 6-volt cables for 12-volt operation do not exceed 14.6 volts at the battery.

ROOFTOP ANTENNAS

New mobile rooftop antenna models—TU316 for the 144-174 Mc. band, TU265 for the 405-420 Mc. band, and TU308 for the 450-470 Mc. band—incorporate several improvements. The new, cone shaped base assembly gives an excellent impedance match be-







tween antenna and transmission line. All antennas give improved performance, particularly in the 405-420 and 450-470 Mc. bands. This new design was accomplished in such a manner that the base assembly requires exactly the same head lining clearance as the earlier models P-8553-B and P-9363. Some early versions had a larger elbow radius and did require more room. The entire antenna assembly can be easily installed from outside the vehicle roof with minimum disturbance to the head lining and upholstery.

Installation is as easily accomplished as it was with earlier models P-8553-B and P-9363, but differs slightly. The Instruction Manual provides a detailed step-by-step description of the procedure which should be followed. A general outline of the procedure is as follows:

1. A ¾-inch diameter hole is drilled in the roof of the vehicle and an electrician's fishtape routed between the roof and the headlining to the rear window or trunk, as desired.

2. A length of flexible hookup wire or strong cord is connected to the fishtape at the rear window or trunk and pulled back through the hole in the roof. *THE FISHTAPE IS USED ONLY TO PULL THE HOOKUP WIRE THROUGH FROM THE REAR OF THE VEHICLE TO THE ROOF.*

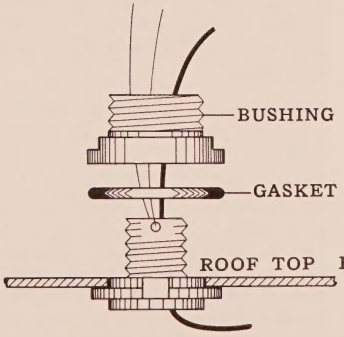
3. The bushing is routed over the upper end of the hookup wire and dropped into the hole in the roof by a strand of "installation" wire included with the antenna. The slotted washer is then dropped over the bushing.

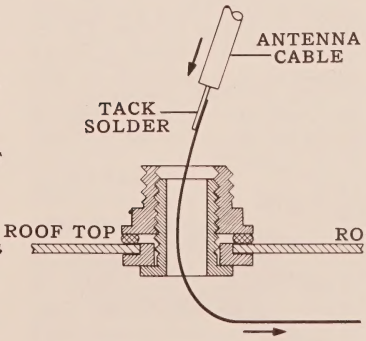
4. The bushing and washer are pulled up into the hole and the gasket is placed on top. The top bushing is then screwed over the bottom bushing and the "installation" wire is removed.

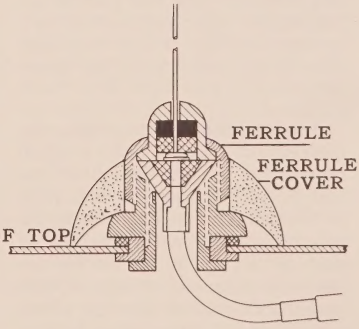
5. The antenna cable is connected to hookup wire and pulled through from the roof to the rear of the vehicle.

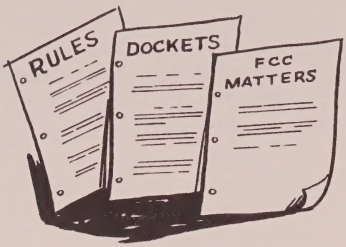
6. The antenna base cone is worked down into position and the antenna rod is connected to the base cone by screwing the ferrule over the bushing. The ferrule cover is then placed over the entire assembly for added protection against the weather.

The cable is cut for the shortest possible overall length which permits connection to the radio equipment in the trunk, and a UHF connector is soldered to the cable for connection to the radio equipment. *CARE IS EXERCISED* ***NOT*** *TO USE EXCESS SOLDER OR EXCESS HEAT. THE CONNECTOR IS CHILLED WITH A WET CLOTH IMMEDIATELY AFTER EACH SOLDERING OPERATION TO PREVENT FLOW OF THE INSULATING MATERIAL IN THE CABLE DUE TO HANDLING WHILE HOT.*









F. C. C. BULLETINS

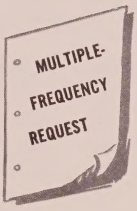
Excerpts from publications of and about the Federal Communications Commission

In a recent Public Notice (FCC 55-1213, dated Dec. 8, 1955), the FCC reports that a number of cases of long distance interference to the mobile services operating between 25 and 50 mc. have been received. The services most seriously affected are the Industrial, Land Transportation, Public Safety, Domestic Public and Remote Pickup. Some reports indicate, for example, that police radio systems are disrupted for hours at a time. Similar disruption of other services is to be expected.

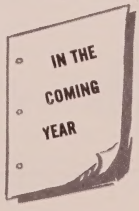
This type of interference is due to the reflection of radio signals from the upper layer of the ionosphere, caused by the rise of the sunspot cycle. Thus radio services separated by hundreds or even thousands of miles, and normally out of range of each other, are able to cause mutual interference. Moreover as sunspot activity increases over the next few years, this long distance interference will continue to increase in frequency and intensity. Because of the heavy occupancy of these frequencies, both foreign and domestic, and the limited opportunities for making adjustments, the FCC is able to afford little if any relief from this interference.

Recommendations — while the interference occurs only a small percentage of the time over the full 11-year sunspot cycle, it is sufficiently frequent and sufficiently intense during the higher part of the cycle, which we are just now entering, to suggest that operators of mobile systems which require a high degree of protection from interference at all times, should give serious consideration to the feasibility of using higher frequencies, which are free from it. Alternatively, if it is decided to continue operation in the 25-54 mc. band, operators should inform themselves of the probable amounts of interference they may expect and make the required adjustments to permit them to perform their necessary functions in spite of the interference.

The ability of the upper, or F2, layer of the ionosphere to reflect frequencies in this range undergoes somewhat irregular cycles of about eleven years each. The eleven-year peak is expected to be reached during the winter of 1957-58, and be similar to the 1937-38 maximum.



In reply to an applicant requesting an additional Special Industrial frequency, the FCC recently spelled out its policy as to multiple-frequency licensing in this service. The Commission said, in part, that "it has been held on a number of occasions that, in the special industrial service, routine operation of more than 100 mobile units within receiving range of a single base station is a prime factor for a satisfactory showing." Citing Section 11.8 (c) of the Rules as governing the assignment of frequencies in this service, the FCC suggested that the applicant expand operations on its presently licensed facilities.



Some FCC actions to look forward to in 1956: Finalization of the Split-Channel proposal, in which the Commission has moved to create new frequency channels in the 25-50 mc. and 152-162 mc. bands by paring down the current spacing between channels in the Common Carrier, Public Safety, Industrial and Land Transportation Services. (See NEWSGRAM, Sept.—Oct., 1955).

Formalization of rules to govern microwave operations—several pending cases involving industrials establishing privately-owned microwave systems may or may not be decided before an overall microwave solution is reached.

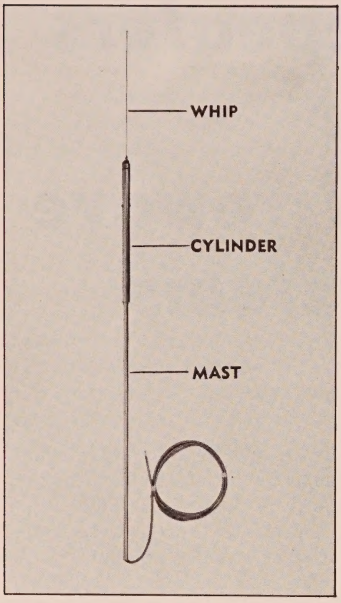
Action on the petition filed by the National Association of Manufacturers Committee on Manufacturer's Radio Use to create a manufacturer's radio service and to establish new frequency channels to be taken from the FM broadcast band with no disruption to FM broadcasting operations. The petition may not be granted in the broadcast band, but indications are that other steps may be taken to give the manufacturers relief.

One rule finalization due fairly soon would permit the use of automobile club two-way radio for reporting traffic conditions from the air during congested road periods. The rule amendments were requested by the American Automobile Association early in 1955 and proposed by the FCC in late November.

A resolution passed by the Associated Police Communications Officers (APCO) last summer requested the FCC to consider the setting aside of one present police frequency in the 30-50 mc. band "to be available to all law enforcement agencies for the operation of low power portable equipment." The request pointed out that police are in need of such equipment for investigation work.

NEW PRODUCTS

LOW STANDING WAVE RADIO OF NEW 450-470 MC. ANTENNAS IMPROVES PERFORMANCE



BUMPER MOUNT ANTENNA

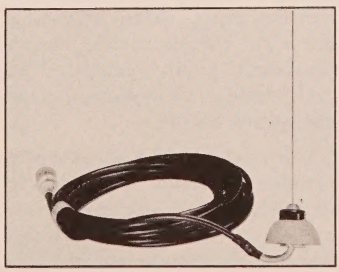
The TU209A Bumper Mount Antenna is a vertically stacked dipole antenna with a radiating aperture of 1.2 wavelengths. One radiating element is a 0.6 wavelength (15 inch) stainless steel whip, and the other is a 0.6 wavelength aluminum cylinder around an aluminum support mast. Total height of the antenna, including the support mast, is about 60 inches. A built-in impedance matching section results in a VSWR of less than 2 to 1 across the 450-470 megacycle band. The antenna is supplied with lead-in cable. Mounting kits are available for installing the antenna on the rear bumper bracket or the side of a vehicle. A model (TU209AT) with a longer support mast is available for mounting on large trucks. It has an overall length of about 84 inches.

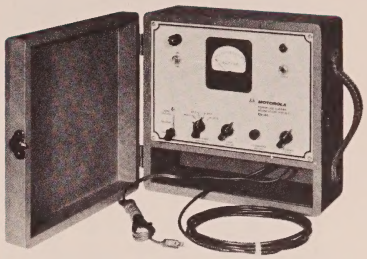
ROOF TOP ANTENNA

The TU308 Mobile Rooftop Antenna is a quarter-wave vertical "whip" radiator about six inches high which mounts on the roof of a vehicle. It can be installed from the outside of the roof with minimum disturbance to the head lining and upholstery. The antenna base assembly provides the same head lining clearance as earlier models such as the P-8553-B and P-9363. A ¾-inch diameter hole in the roof is required for installation.

The whip radiator is connected to the antenna lead-in cable by an impedance matching cone and a smoothly curved tube of silver-plated brass. These two elements minimize reflection of the transmitted signal, greatly increasing antenna efficiency. The VSWR voltage standing wave ratio) of the entire antenna assembly, including the lead-in cable and connector, is less than 2 to 1 across the 450-470 megacycle band.

The antenna is supplied complete with all necessary mounting hardware, lead-in coaxial cable and UHF connector. It is installed as easily as earlier models. A special "L" wrench and length of wire are included to facilitate installation from outside the vehicle roof. The "whip" is stainless steel and all other parts are weather-resistant. The assembly provides a completely weather-tight installation.





NEW POWER LINE CARRIER MODULATION TEST SET

The CU135 Power Line Carrier Modulation Test Set is a direct-reading FM deviation meter which can be used with Motorola power line carrier equipment, or any FM power line carrier equipment with an intermediate frequency of 455 or 475 kilocycles. It enables accurate, convenient adjustment of system modulation levels.

The unit contains the 1st and 2nd limiter, discriminator and audio amplifier stages of a standard power line carrier receiver. The deviation meter circuit is connected to the discriminator output, in parallel with the audio amplifier, and indicates carrier deviation in kilocycles. An audio amplifier output jack provides a convenient connection for measurement of signal quality. A built-in crystal-controlled oscillator enables accurate calibration of the deviation meter circuit in the field.

The test set has a built-in power supply, and will operate from any conventional 117 VAC outlet. It is packaged in an attractive tan simulated leather carrying case approximately 12 x 11 x 16 inches and weighs 10 pounds. A test lead and AC power cord are included.

20 x 24-foot passive repeater used by Pacific Power and Light Company. Repeater is located on a hill about 1.2 miles from one of the microwave stations.

Passive Repeaters for Microwave Systems

The super-high frequency microwave energy transmitted by Motorola microwave equipment (6000-7000 megacycles) behaves similarly to light and is transmitted in a searchlight-type beam which can be efficiently deflected by properly designed reflectors. Tower-mounted reflectors are used at standard Motorola microwave stations to increase the height of the transmission path for the required "line of sight" condition between stations.

This reflection phenomenon also permits a large reflector to be placed at an elevated site between the stations to deflect the microwave energy over or around an obstruction. Since such a reflector is somewhat remote from the microwave station and repeats the microwave energy without the introduction of additional power or electronic amplification, it is called a passive repeater.

APPLICATION

When a "line of sight" transmission path cannot be obtained with practical tower heights, the passive repeater can often be utilized. As the alternate solution, the microwave equipment could be placed at the elevated site to obtain a "line of sight" microwave path, and the audio circuits brought back to the desired location by wire lines or other radio equipment. This latter approach has many disadvantages.

Wire lines are expensive to install and maintain and are vulnerable to bad weather conditions. A pair of wires is required for each audio circuit, unless carrier equipment is used. Carrier equipment or any other type of radio equipment at the remote site requires power and maintenance, often in hard to reach, bad weather areas. Also, extending the audio circuits usually lowers the circuit quality compared to that provided by a point-to-point microwave circuit.

If availability of a suitable site permits utilization of a passive repeater, electronic equipment and associated power requirements at the remote site are eliminated and the microwave equipment can be located in close proximity to the desired audio circuit drop points. Furthermore, maintenance usually amounts to no more than an annual expedition, at the convenience of the weather and personnel, to clear brush away from the front of the repeater.

TRANSMISSION CHARACTERISTICS

Although the reflecting surface of the passive repeater is flat, it can be considered as a small portion of a huge parabolic reflector which would have a very large gain. A well designed passive repeater re-radiates almost 100% of the microwave energy it intercepts, and re-focuses it into a narrower beam. Large passive repeaters actually contribute gain to the system.

DESIGN CONSIDERATIONS

The cost of a passive repeater is, of course, proportionate to its size. General practice is to use

the smallest size consistent with the allowable circuit loss for reliable communications. Standard antennas with 40-inch diameter paraboloids and 6 x 8-foot tower-mounted reflectors (if used) can usually be used at both microwave stations. However, it is usually more economical to add more gain at the point sources than to use a larger passive repeater. Motorola manufactures 6-foot diameter parabolic reflectors and 8x12-foot tower-mounted reflectors for use in standard installations where maximum gain is needed.

The structural rigidity and other related characteristics such as face flatness must be maintained within certain limits under all conditions of operation to insure continuity of optimum system performance. In general, the structural design should withstand 30-pound wind loading (with or without ice depending on the climate) with nominal deflection rigidity of $\pm\frac{1}{4}$ the beamwidth in all directions and a flatness variation of $\pm\frac{1}{8}$ wavelength across the face of the repeater.

The face sheets of the repeater can be perforated to reduce wind loading. Circular perforations of less than $\frac{1}{8}$ wavelength make the sheet appear electrically as a solid to the microwave energy.

STRUCTURAL TYPES

There are two general structural classifications of passive repeaters — self-supporting and guyed. Repeaters larger than 300-square feet in area are usually self-supporting and rest on concrete piers. The perforated aluminum sheets are attached to a rigid aluminum angle frame which has aluminum supporting channels brought back to a foundation behind the face of the repeater. The sizes of the frame members, methods of bracing and fastening are all determined by wind loading and structural rigidity requirements.

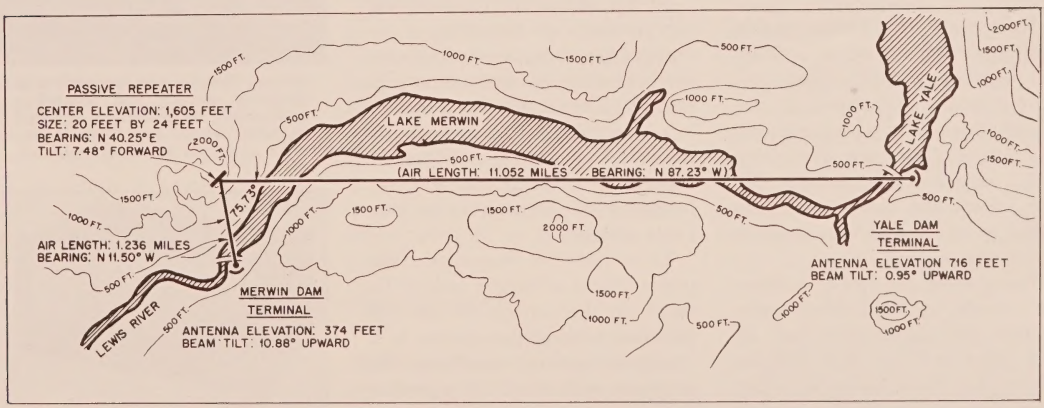
If system design permits a passive repeater with a smaller face, the perforated aluminum screen can be mounted on a frame attached to a tower or between a pair of poles imbedded in a concrete foundation. Since the face of the repeater need only be high enough for "line of sight" clearance over brush or snow, tall poles are usually not needed and a very economical and satisfactory installation is possible. The poles may or may not be guyed depending on rigidity requirements.

INSTALLATION

The installation of a passive repeater generally involves no serious problem other than transporting the material to what may be a rather isolated location. Weight is minimized, since almost all material is aluminum. Erection of the structure is straight-forward and can be performed by a labor crew under supervision of a competent foreman or engineer. Alignment is accomplished by focusing the antennas of the adjacent microwave stations on the face of the repeater and adjusting the angle of the repeater for optimum communication between stations.

OPERATION

Passive repeaters used in Motorola microwave systems have performed exceptionally well. System performance has not been affected by heavy wind and ice conditions, and except for annual brush-clearing expeditions, maintenance requirements are nil. The application of passive repeaters is well suited to Motorola microwave equipment and provides a practical and economical solution to transmission of microwave energy in many geographical situations.



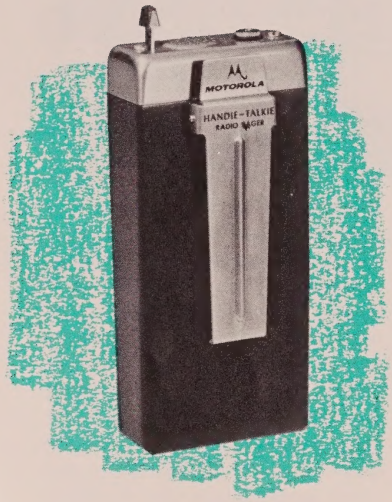
Map shows how passive repeater is used to deflect the microwave energy around a 2000-foot hill. Motorola microwave system provides communication between two power dams of the Pacific Power and Light Company.

NEW PORTABLE PRODUCTS

TRANSISTORIZED Handie-Talkie®

RADIO POCKET PAGER

New Transistorized Wireless Paging System Provides Truly Private Plant-Wide Calling



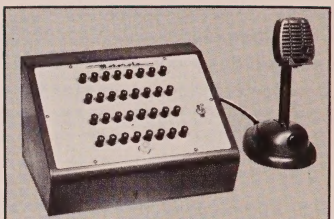
Motorola's new radio paging system, permitting silent, individual paging anywhere within a restricted plant or institution area, quietly does away with the necessity for audible and disturbing public address type calling. No one except the individual being called is aware that a message is being transmitted.

The system consists of a selector console, with individual push-buttons for paged personnel, an FM transmitter that radiates alerting tones and voice messages into an inductive loop encircling the plant area, and individual, all-transistorized HANDIE-TALKIE radio paging pocket receivers. Any number of receiver units can be utilized depending on the scope of the system. The number of individual calling codes available is more than adequate to accommodate any paging requirement. A receptionist or switchboard operator merely presses the proper selector button on the console to activate a particular receiver alerting mechcanism, then speaks into a desk microphone. No other receiver in the system hears either the alerting tone or the message which follows.

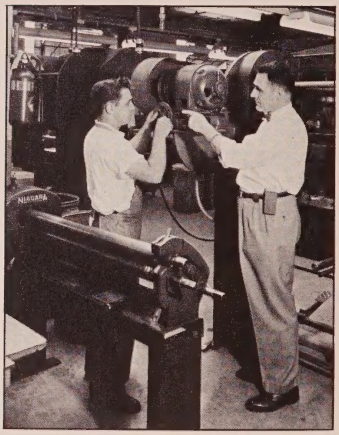
CONTROL POINT

At the control point, usually the receptionist's or switchboard operator's position, a selector console and desk microphone are installed. The transmitter, which is connected to the console by 25 to 50 feet of cabling, need not be accessible to the operator and may be installed anywhere within cable distance.

To operate the transmitter, the pager places a toggle switch located on the console in the ON position, putting the system in a "ready-to-operate" condition. To page one individual, the operator depresses a single push-button on the console which corresponds with the pagee's receiver number.



Selector Console and desk type microphone provides alerting mechanism and message delivery facilities.



Above, Maintenance supervisor is instantly alerted and located — overcoming disadvantages of visual systems which may fail to attract attention for some minutes.

FM transmitter takes alert tones and voice signal input and radiates output into encircling inductive loop.

The button is held down for a few seconds and then released. After pausing a moment, the operator then presses the "push-to-talk" button on the microphone and relates the message. When paging more than one person, the operator presses each pagee's selector button individually.

The transmitter unit is a crystal controlled FM transmitter designed for operation on a specific frequency in the 50-100 kc. range. The RF output power is about 10 watts. There are two audio inputs: one for the alerting tones, the other for voice signals. Transmitter deviation is limited to ± 2.5 kc. for full modulation.

There is no FCC license required for the transmitter used with HANDIE-TALKIE radio paging receivers because it utilizes the inductive loop method of restricted radiation, rather than far-ranging radio signals. Radiation into open exterior areas is about 150 feet from the wire loop; interior coverage extends about 75 feet from the loop. In multi-story buildings complete coverage is obtained by installing more than one loop—usually one every third floor.

Dr. John Otten, of Chicago's busy Presbyterian Hospital, relaxes in the locker room after an operation confident that he is instantly available for emergency messages.

RECEIVER

The HANDIE-TALKIE Paging Receiver, using Motorola transistors throughout, weighs only 10 ozs. and measures slightly larger than a king-size package of cigarettes. The receiver can be clipped to a pocket or worn on a belt by the pagee. Powered by a 4-volt mercury cell battery, its FM reception is essentially immune to common types of interference generated by X-Ray, diathermy and other noise generating equipment found in the modern hospital or industrial plant. Battery life is approximately four 40 hour weeks. Unit operating cost is only 3 cents per 8 hours work day.

The receiver contains a miniature "Vibrasponder" resonant reed relay which is attuned to the frequency of the individual paging tone. When the tone is received, the reed vibrates at its resonant frequency and produces an audible buzz in the receiver speaker. Thus the pagee is alerted to a forthcoming message. He then presses a "push-to-listen" button and waits for the ensuing message. If desired, a lapel speaker or hearing-aid type earpiece may be substituted for the built-in speaker facilities when used in a high ambient noise area. Inserting either the lapel or earpiece plug into a jack on the top of the receiver will transfer the audio output to the external speaker.

APPLICATIONS

The radio paging system can eliminate the noise factor in bells and buzzers or voice transmissions over a public address system. Also the selective paging feature can be expected to relieve "paging insensitivity" in those who are called frequently. Particularly in hospitals, restricted use of public address can make greater privacy possible, preserve silence during sleeping hours, and conceal emergency situations which might be upsetting to the patients.

In industrial plants, executives, maintenance men, expediters and other key personnel can be singled out quickly and silently. When production equipment breaks down, a particular maintenance man can be notified in seconds. Telephone "chasing down" and callbacks for busy executives can be eliminated because all the information gets to the paged person individually, instantly and directly.

Practicality of the product and its application has been proved through initial installations of the radio paging system in several leading hospitals, factories and large office buildings. » » »

TRANSMISSIONS . . . On Communications Topics

Flexible Delivery Dates

News of recent blizzards reminds us that two-way radio is often of incalculable value when life, limb or property are at stake. Consequently, our delivery schedules sometimes go out the window when an emergency order is received.

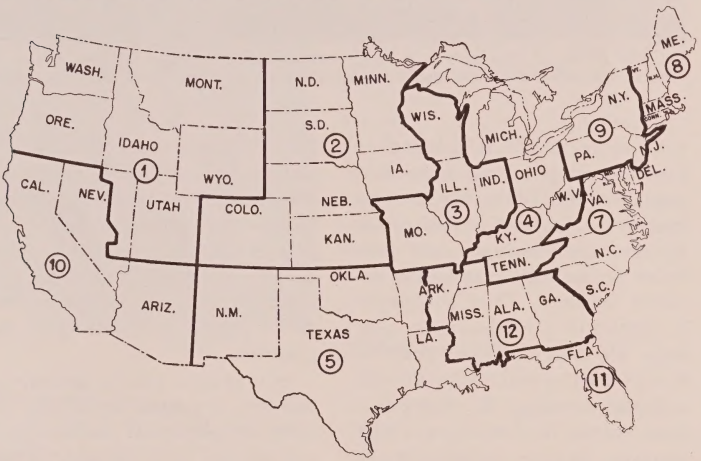
For example, last year a severe blizzard downed 1000 miles of line of the Pacific Power and Light Co. at Casper, Wyoming. They placed an emergency order for 10 mobile units with their Motorola radio communications engineer who immediately called the Motorola plant in Chicago. A special crew worked during the night grinding crystals and fabricating the units which were shipped by Air Express the next day.

Another instance of such an emergency is described in this issue of the Newsgram on pages 4 and 5. Motorolans worked Saturday night, Sunday, and Sunday night on radio units that helped Standard Oil Co. combat a catastrophic fire at Whiting, Ind.

Two weeks later the State of California urgently needed 10 "Handie-Talkie" portable pack sets to fight a raging forest fire. The order was received late Saturday and Motorolans worked Saturday night and Sunday assembling and testing units that were delivered late Sunday in California. The portable radiophones were immediately put to work at the fire line. As a result, R. E. McArdle, Chief of the United States Forestry Service expressed his appreciation in a telegram to Dan Noble for "this special effort which contributed materially to the task of controlling the disastrous fires."

The moral of these stories is that a certain amount of flexibility in delivery must be maintained. Motorola customers know that in an emergency they can depend upon Motorola people to do their part in saving life and property. » » »

REGIONAL DIRECTORY . . .



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Phone: ATLANTIC 8-5428

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Phone: WEBSTER 0017

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Phone: ESTEBROOK 9-0122

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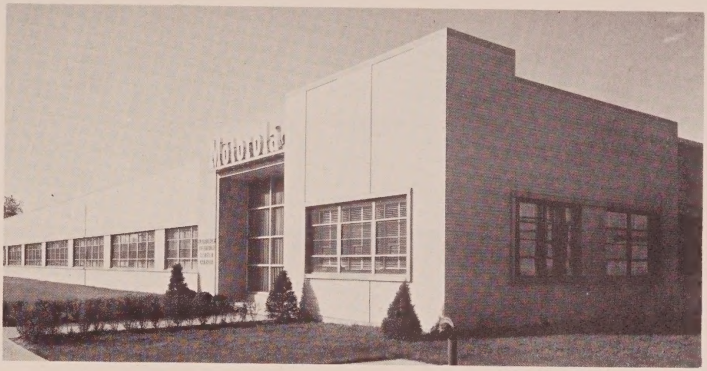
Motorola Expands Microwave Facilities



Daniel E. Noble, Vice President in Charge of Motorola's Communications and Electronics Division, has announced relocation of the division's Microwave and Industrial Products Department into new and expanded office, manufacturing and engineering quarters. This phase of the company's activity, previously at the Chicago headquarters location, will now be centered in a modern, one-story structure a few blocks away. The new address of the department is 1400 N. Cicero Avenue, Chicago 51, Illinois.

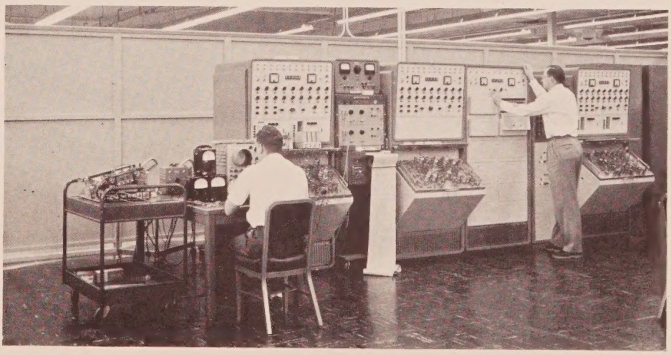
Mr. Noble said the new facilities were needed to accommodate increased sales of microwave systems, supervisory control and power line carrier equipment. More efficient layout and improved materials handling methods incorporated in the new plant will greatly increase production capacity. Larger laboratory and systems engineering facilities are also provided. "Sales of microwave equipment reached an all time high in 1955," said Noble, "and we expect a continued upward trend."

MOTOROLA-RIVERSIDE, CALIFORNIA

Expands Analog Computer Facility

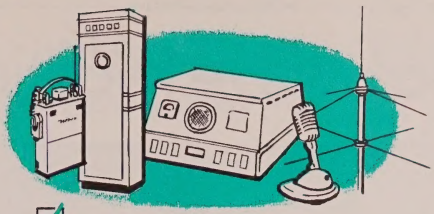
To handle government contracts for increasingly complex design work, Motorola's Research Laboratory at Riverside, Calif. recently increased its analog computer facilities by 30%. The staff, which pioneered in the design, operation and use of analog computers for guided missiles, uses the computer as an every-day tool for a wide variety of activities.

The analog computer facility is especially valuable for the analysis and design of servomechanisms and has been indispensable in the development of nonlinear equipment. It is employed as a means of simulating flight so that the optimum airframe design can be obtained that is compatible with such elements as guidance and auto-pilot units. In this way its use minimizes the amount of field testing required for the final design.



Left, Joseph A. Kelly, aeronautical engineer at the Motorola Research Laboratory, makes frequent use of the analog computer. Right, A part of the analog computer facility at Riverside.

(Photo Courtesy Riverside Daily Press)



COMPLETE PRODUCT LINE

of mobile radio equipment custom-engineered for service in the VHF and UHF bands. Radio sets are interchangeable without modification between 6 and 12 volt cars. Selective calling equipment, MOTOROLA QUIK-CALL, can be easily added for private operation.

TECHNICAL FIELD FORCE

Motorola radio communications engineers are specialists in 2-way mobile radio systems and are technically qualified to help determine the best solution to your communications problem. Field engineers represent Motorola in every part of the U.S., assuring customer satisfaction by maintaining contact *after* a sale.

CHOOSE MOTOROLA

Because it's the COMPLETE communications service

- ENGINEERING
- PRODUCTS
- PARTS
- INSTALLATION
- MAINTENANCE
- FINANCE

FINANCING YOU WANT

Motorola, the complete communications supplier, will furnish you the equipment you need on any terms you desire; cash purchase, installment plan, lease with or without equity and allowance for optional purchase.

INSTALLATION & MAINTENANCE

by the Motorola National Service Organization — largest and most experienced in 2-way mobile communications. Over 750 authorized Motorola Service Stations offer low-cost, 24 hour service with genuine Motorola parts.

The Motorola radio communications engineer in your area will be glad to discuss your radio problem. Phone, wire, or write TODAY.

MOTOROLA

2-WAY RADIO

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Proof of acceptance, experience and quality.
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